Radio Construction and Repair Work

LESSON 7X2

SPRAYBERRY ACADEMY of RADIO

ESTABLISHED 1932

PUEBLO, COLORADO

RADIO CONSTRUCTION AND REPAIR WORK

Directions on How to Finish Wiring Your Receiver

LESSON NO. 7x2

Demonstration No. 17

How to Mount the Filter Condenser

The filter condenser is part No. 18163 and contains two 20 mfd. electrolytic condensers rated at 150 volts. This condenser is to be mounted on the inside rear flange of the chassis. Note this unit has a metal strip around it with a hole near the end of the strip. Refer to Fig. 5 of lesson 7x1 and note the mounting position of this condenser. The end with the two red leads should be nearest the 35Z5 socket, and the end with the single black lead should be nearest the 12SK7 (IF) socket. Mount the condenser unit with a ¼x6-32 screw, nut and lock washer. You will find a mounting hole in the rear chassis flange near the point where the power cord enters the flange. With the condenser properly mounted solder one of its red leads to No. 4 of the 35Z5 socket and solder the other red lead to No. 8 of the same socket. Finally solder the single black lead to one of the grounded terminals of the 12SK7 (IF) socket.

You will see that No. 4 of a 35Z5 socket is blank—thus it may be used as a connecting terminal for other circuits. Later when you connect the choke coil, this circuit will be extended. The filter condenser is now connected between 4-8 of the 35Z5 socket and ground. The next step is to include the filter choke coil.

Demonstration No. 18

How to Mount the Filter Choke

The iron core choke is part No. 25275 and has two leads. It is to be mounted on the top side of the chassis somewhat to the left of the 12SK7 (RF) and 35Z5 tubes. The relative position for it is shown in Fig. 1 of this lesson. Just to the left and to the rear of where the choke is to mount, you will find a ⅜ inch hole in the chassis. Insert in this hole one of the ⅜ inch rubber grommets. Next mount the choke so that its two leads are nearest the ⅜ hole with rubber grommet. To mount the choke, use two ¼x6-32 machine screws, washers and nuts. Insert the screws from the top side of the chassis, using washers and nuts on the underside of the chassis. When you have the choke mounted, solder one of its leads to No. 8 of the 35Z5 socket and solder the other lead to No. 4 of the same socket. Note this connects the choke coil between the two 8 mfd. condensers with No. 8 of the 35Z5 socket being the input terminal feeding the filter network. Terminal No. 4 of the 35Z5 socket now becomes the output of the filter feeding the various B+

circuits. Keep in mind that No. 4 of the 35Z5 socket is a blank terminal for this type of tube and may, therefore, become a common connecting point for several circuits as will be brought out later.

Demonstration No. 19

Mounting the Speaker

The speaker mounts near the left front of the chassis. It is to be mounted with two ½x8-32 machine screws. Two insulating washers should be used between the speaker frame and chassis. You will note six of these washers are included, permitting up to three each to be used with each mounting screw. This permits raising or lowering of the speaker with respect to the chassis should you find that desirable. To mount the speaker, insert the ½x8-32 screws from the underside of the chassis. You will note the mounting holes in the speaker frame are threaded, permitting the insertion of the 8-32 screws. Use the insulation washers previously mentioned and turn the screws until they are tight. This will firmly hold the speaker to the chassis. To the left of the speaker, you will find a 5-16 inch hole in the chassis. Insert the 5-16 rubber grommet in this hole, and then feed the blue and red wires of the speaker down through this hole. Connect the red wire to No. 3 of the 35L6 socket and connect the blue wire to No. 4 of the same socket. The No. 4 terminal of this socket is the screen grid of the 35L6 tube so it is used to complete the B+ circuit to the plate of the tube. This is permissible since both the screen grid and plate get their B+ voltage from the same circuit as will be brought out later. If it should happen that your speaker leads should be green and brown or some other color, do not let it confuse you as it does not make any difference how the two leads are connected to 3 and 4 of the 35L6 tube with respect to polarity.

Demonstration No. 20

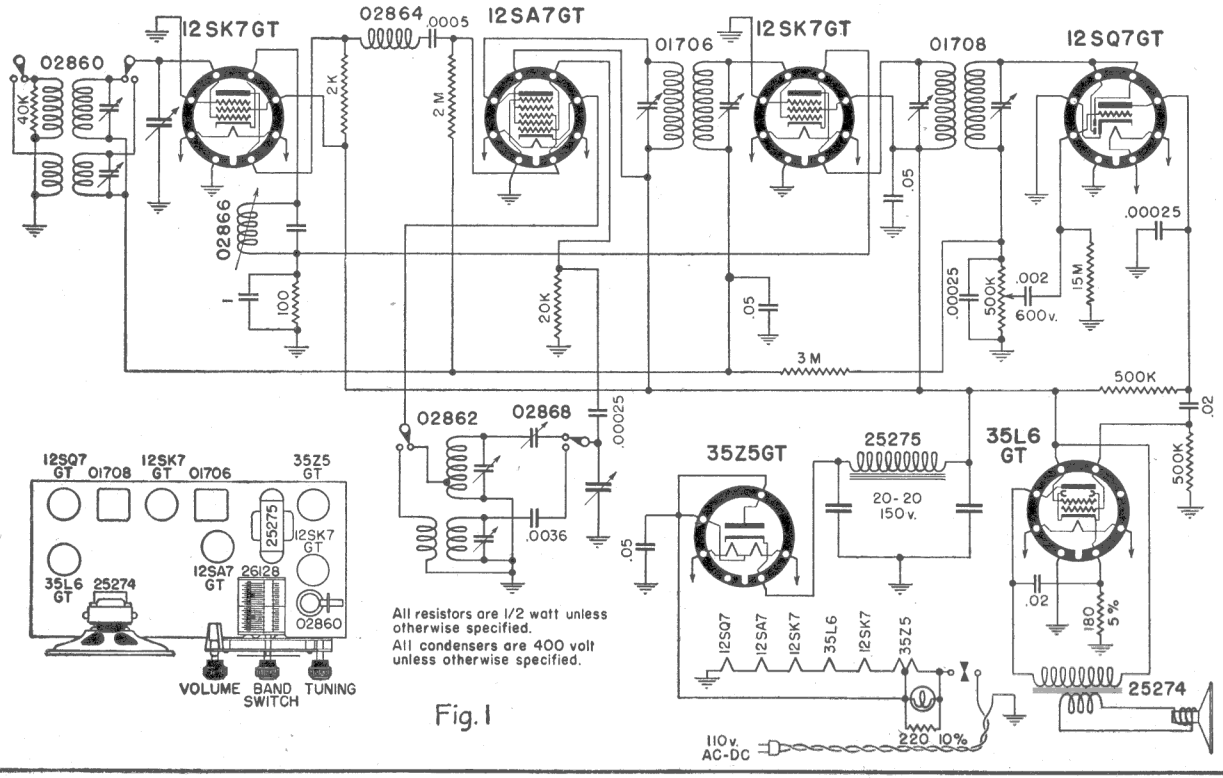
Establishing the B+ Feed Circuit

Refer to Fig. 5 of lesson 7x1 and note the large hole in the chassis where the 2nd IF transformer is to be mounted (near the 12SQ7 socket). At the left edge of this mounting hole, observe that the drawing shows one of the two terminal tie lugs in position. *Ordinarily this tie lug is held in place by one of the mounting screws of the IF transformer.* However, until the latter is mounted, temporarily hold the tie lug in place with one of the ¼x6-32 screws. Use the tie lug which has the mounting foot to the left (when the mounting foot of the tie lug is towards you). The other two-terminal tie lug with the mounting foot to the right is to be used later.

The purpose of the tie lug is to provide a convenient tie-in or common point for the B+ circuit. To extend the B+ feed line, connect a wire from No. 4 of the 35Z5 socket to No. 6 of the 12SK7 (IF) socket and connect another wire from the latter terminal to the *insulated terminal* of the tie lug. Next connect a wire from No. 6 of the 12SK7 (IF) to No. 4 of the 12SA7 and connect another wire from the latter terminal to No. 6 of the 12SK7 (RF). Next connect a wire from the insulated terminal of the tie lug to No. 4 of the 35L6 socket.

BC & SW AC-DC RECEIVER

I. F. = 456 kc



All resistors are 1/2 watt unless otherwise specified.

All condensers are 400 volt unless otherwise specified.

Fig. 1

Finally, identify your 500,000 ohm resistors. There are two of them, and one of them is to be used at this time. They are colored green-black-yellow. Connect one of these resistors from the insulated B+ tie lug to No. 6 of the 12SQ7 socket. This completes the B+ feed line from No. 4 of the 35Z5 socket to at least one terminal of each of the sockets. Directions for continuing this part of the circuit will be given later.

Demonstration No. 21

Testing the Plate Circuit of 35L6 Tube

None of the circuits of the tubes are complete as yet, but the circuit of the 35L6 tube is complete enough to permit making a test of it and so getting a check on your wiring up to this point. First check over all your wiring to see that you have followed directions properly. Then see that all tubes are inserted in their respective sockets and that there are no loose wires or wrong connections that might cause a short circuit. Then plug in the line cord, turn on the switch and allow the tubes time to heat. Next touch a screw driver blade from No. 8 of the 35L6 socket to ground. This should produce a loud click or noise from the speaker. Such a noise click or test proves the 35L6 tube is correctly wired up to this point. When the No. 8 terminal of the 35L6 socket is shorted, it completes the cathode circuit to ground and so completes the plate circuit of the tube. Normally, however, the 180 ohm resistor is used between the cathode of the tube socket and ground as will be explained in the next demonstration.

Demonstration No. 22

Input Circuit of the 35L6 Tube

Identify the 180 ohm resistor, (brown-gray-brown) and connect it from No. 8 of the 35L6 socket to ground—see Fig. 5 of 7x1. Next connect a .02 mfd. condenser from 3 to 8 of the 35L6 socket. With this done, connect the receiver to the line, and after the tubes have warmed up, touch your finger momentarily to No. 5 of the 35L6 socket. On doing this, you should hear a loud buzz from the speaker signifying that the stage is working properly. With no circuit connected to the grid, it is extremely sensitive—your finger touching it allows the accumulation of electrons to leak off the grid which is what causes the buzz. The same effect would be noticed in almost any stage of a receiver which had an open grid circuit. Next connect the remaining 500,000 ohm resistor from No. 5 of the 35L6 to ground. In making this connection, connect the resistor between No. 1 and 5 of the socket—letting the extra wire length on the end of the resistor extend down to the ground terminal of the socket from the No. 1 terminal. This will ground the resistor and will, at the same time, ground the No. 1 terminal which is required for this tube. Next connect one of the .02 mfd. condensers from No. 5 of the 35L6 to No. 6 of the 12SQ7. With this done, connect one of the .00025 mfd. mica condensers from No. 6 of the 12SQ7 to ground. This condenser is colored black-red-green on the top row of dots and black-black-brown on the bottom row of dots. This completes the input wiring to

the 35L6 tube. To test it, turn on the receiver as usual and after it has warmed up, touch your finger to No. 5 of the 35L6—note a faint buzz or hum is now heard from the speaker. Next move your finger to No. 2 of the 12SQ7 tube. This time a louder buzz should be heard showing some amplification is being obtained from the 12SQ7. Note, too, the 12SQ7 grid is free whereas the 35L6 grid is properly connected with its 500,000 ohm grid leak. This proves a loaded grid or one properly connected will produce less buzz than one which is free or floating, as in the case of the 12SQ7.

Demonstration No. 23

The Triode Grid of the 12SQ7

Connect the 15 megohm (brown-green-blue) resistor from No. 2 of the 12SQ7 to ground (see Fig. 5 of 7x1). Next mount your remaining two-terminal tie lug using the mounting screw of the 35L6 socket to hold the tie lug in place, as in Fig. 5 of 7x1. Next connect the .002 mfd. condenser from No. 2 of the 12SQ7 socket to the insulated terminal of the tie lug you have just mounted. Next connect a wire from the tie lug to the center terminal of the 500,000 ohm volume control. Next connect one of the .00025 mfd. mica condensers between the two outside or end terminals of the volume control. Finally, with the chassis turned upside down and with the rear of the volume control towards you, just as in Fig. 5 of 7x1, connect the left end terminal of the volume control to ground by connecting a wire between the terminal of the volume control and one of the grounded terminals of the 12SA7 socket. To check the effectiveness of the volume control, turn on the receiver, and, after the tubes warm up, touch your finger first to the right end terminal at the same time turning the volume control knob. Note a loud buzz is obtained when you do this, and the position of the volume control knob will control the loudness of the buzz—thus proving the volume control is working. This completes the wiring of the triode grid of the 12SQ7 tube—the diode plates of the tube are to be wired next.

Demonstration No. 24

Diode Circuit Must Be Loaded

The 12SQ7 tube is a multi-function tube in which the diode plates and the cathode of the tube perform detection and the triode grid, plate and cathode provide amplification after detection. You have wired the triode section of the tube and have, no doubt, proven by now that it operates properly. Since the cathode is common to both diode and triode sections, it would seem that if the diode plates were touched (static charges in the body providing a signal) that a loud buzz would be obtained as when touching the triode grid. However, when the diode plates are connected together and touched, you will note only a faint buzz is heard—in fact, if a strong AC 60 cycle signal is fed the diode plates, very little hum or buzz will be heard. This is because the diode plates are not as sensitive as the triode grid, and also because there is no circuit from the diode plates to the cathode. You can prove this to be true by connecting terminals 4 and

5 of the 12SQ7 tube together and then touching them as directed. Note that by connecting 4 and 5 of the 12SQ7 together, the diode plates form one common element for half-wave detection. In the next demonstration, when the secondary of the IF winding is in the circuit from the diode plates to the volume control, it will be shown that the sensitivity of the diode plates will be tremendously improved.

Demonstration No. 25

Mounting the Output IF Transformer

This receiver uses two IF transformers—an input and output type. The input unit is No. 01706, and the output is No. 01708. These numbers are stamped on the boxes the coils are shipped in and also on the shield can of each unit. The output or the No. 01708 unit is to be mounted first. Refer to Fig. 5 of 7x1 and note the relative position of this unit—it is to be mounted between the 12SQ7 and 12SK7 (IF) sockets. Before mounting the unit, remove the temporary ¼x6-32 screw you used to hold the two-terminal tie lug in place as one of the IF coil mounting screws can now be used for holding the tie lug in place. To mount the IF coil, feed its four wires through the large hole in the chassis from the top side. Then see that the two mounting screws fit properly into the two holes provided for them. On the underside of the chassis use a lock-washer and nut on each mounting screw—turn the nuts tight until the IF coil is held firmly in place. Next connect the green lead of the IF coil to 4 and 5 of the 12SQ7 socket. The three-terminal tie lug is to be mounted near the 12SK7 (IF) socket—see Fig. 5 of 7x1. In mounting this, use a ¼x6-32 screw, inserting it from the topside of the chassis and tightening on a nut and washer underneath. Next solder the black IF coil lead to the left end of the insulated terminal of this three-terminal tie lug (See Fig. 5 of 7x1). From this same tie lug connect a wire over to the right hand terminal of the volume control. These connections place the secondary of the IF coil between the two diode plates and the cathode of the tube. The secondary winding thus forms the AC load and the 500,000 ohm volume control becomes the rectifier load—its circuit being completed back to the cathode through the 15 megohm resistor.

Demonstration No. 26

Testing the Diode Input

With the secondary of the IF coil properly connected, a load is formed from the diode plates to the cathode, and this part of the circuit now becomes very sensitive. To prove this, turn on the receiver, and, after it has warmed up, touch your finger or a metal tool to the two diode plates. This time you will note there is a loud buzz which you can control by the position of the volume control knob. You will note the blue and red leads of the IF coil (the primary is still not connected) are still free. However, if you will touch only one or both of these leads with your finger while the volume control is turned on full, a medium level buzz will still be heard from the speaker. Thus, this proves that energy can be transferred between the two

coil windings. This same test may be made on any other similarly connected receiver. It is a good general test to remember.

Demonstration No. 27

Checking Output of the 12SK7 IF Tube

Connect the blue lead of the IF coil to No. 8 of the 12SK7 IF tube and connect the red lead to the nearby B+ feed line at the two-terminal tie lug. This will connect the primary of the IF coil from the plate of the IF tube to B+. However, the tube will still not draw plate current because its cathode circuit is incomplete. Thus, while the receiver is operating, you can touch your finger or a small metal tool to either terminal 8 of the tube socket or to the B+ connection, and very little, if any, hum will be heard although there may be a click heard on making or breaking contact with the IF tube plate circuit. Later you will see that this condition will no longer hold true when the input circuit to the tube is completed. To finish wiring the plate circuit of the IF tube, connect a .05 condenser from the point where the red lead of the coil connects to the B+ circuit or from No. 6 of the IF tube to ground. Figure 5 of 7x1 shows the correct relative mounting position for this condenser. Note this condenser acts as a by-pass for both the plate and screen grid circuit of the IF tube.

Demonstration No. 28

How to Mount the IF Wave Trap

In order to complete the wiring of the IF cathode circuit, it will first be necessary to mount the IF wave trap coil which is also a part of the RF wiring. The wave trap is part No. 02866 and is mounted on an insulating block along with a fixed mica condenser. The relative mounting position of this part is shown in Fig. 5 of 7x1 between the 35Z5 and 12SK7 RF sockets. First examine the wave trap and note it consists of an iron core coil. Two nuts are around the adjustable core. Do not disturb the larger nut as it holds the coil in place. However, you are to remove the smaller nut and the adjacent screw with washer before mounting. The entire unit mounts from beneath the chassis with the adjustable core extending through one hole in the chassis with the other screw hole in the insulating block appearing over the mounting hole in the chassis. Center the adjustable core through its mounting hole as near as you possibly can and then from the topside of the chassis, insert the screw which you removed from the insulating block and turn this screw into the threaded metal piece of the insulating block until it is firmly tight. It is this screw which holds the entire assembly tight so be sure it is firmly tight and that its lock washer is used. The small nut which you removed from the adjustable core can now be replaced on the core from the top side of the chassis. Do not turn it tightly against the top of the chassis as this will be done later on when you adjust the wave trap.

Demonstration No. 29

Cathode Circuit of IF Tube

The cathodes of the RF and IF tubes are common through the 100

ohm resistor to ground. To complete the IF cathode circuit, connect a wire from No. 5 of the 12SK7 IF socket to one side of the wave trap—see Fig. 5 of 7x1. To this same terminal must be connected one end of the 100 ohm resistor and one end of the .1 mfd. condenser. In connecting the wire ends of the resistor and condenser to one side of the wave trap, be very careful and do not cause a ground to occur, such as letting hot solder run down beneath the insulating block. You will note this block is very near the metal chassis, and, therefore, it would not take much excess solder to form a short circuit between the chassis and wave trap terminal. Try to make your connection high up on the terminal, and you will not have any trouble. After connecting the wire lead, resistor and condenser to the wave trap terminal, connect the other end of the resistor and condenser to the grounded terminal of the nearby 12SK7 RF socket. With this done, the cathode circuit of the IF tube will be complete. There are two terminals on the 12SK7 IF socket which should be grounded. These are Nos. 1 and 3—ground them to the one of the grounded terminals on the same socket.

Demonstration No. 30

Input Circuit of IF Tube

With the cathode circuit of the IF tube complete to ground you can now test the input effectiveness of this tube. In this connection, note that the same test can be made on any other IF stage as long as the control grid of the tube is floating or not connected. Thus, to make this test on any other receiver, it would first be necessary to disconnect the control grid and then make the test. First turn on the receiver and let it reach operating temperature. Then turn the volume control on full. Next touch the No. 4 or control grid terminal of the 12SK7 IF tube with your forefinger. This should cause a pronounced buzz or hum. You can vary the degree of this by touching the No. 4 terminal with your forefinger and the chassis of the receiver with the thumb of the same hand. In doing this make sure your forefinger touches only the No. 4 terminal and not the No. 6 or 8 terminal because these are at a B+ potential. The thumb on the chassis and forefinger on the No. 4 terminal forms a grid leak for the control grid. Thus, less impedance is formed for the grid, and that is why the buzz or hum changes pitch when the thumb touches the chassis.

Demonstration No. 31

Mounting the Input IF Transformer

The input IF transformer is No. 01706. It is to be mounted just as in Fig. 5 of 7x1—that is, to the right of the 12SK7 IF and in the rear of the 12SA7 socket. This is mounted in the same relative way as the output IF coil. Mount the coil from the top side of the chassis using nuts and lock washers on the underside of the chassis to hold the entire unit in place. This transformer has four leads colored blue, green, red and black. Connect the green lead to No. 4 on the 12SK7 IF socket and connect the blue lead to No. 3 on the 12SA7 socket. Con-

nect the red lead to No. 6 of the 12SK7 IF—this latter terminal you will note corresponds to the common B+ feed line and so provides voltage for the plate of the 12SK7 through the primary winding of the IF coil. The black lead of the IF transformer involves the AVC circuit and will be described in the next demonstration.

Demonstration No. 32

The AVC Circuit

You will remember under demonstration No. 25 that you mounted a three-terminal tie lug. The center terminal of this tie lug is grounded and the left end of it has the black lead from the output IF transformer connected to it. Next you should connect the black lead from the input IF transformer to the right end of this three-terminal tie lug. Next connect the 3 megohm resistor (orange-black-green) between the left and right terminals of the three-terminal tie lug—Fig. 5 of 7x1 shows these connections. Finally, connect, a .05 mfd. condenser from the right terminal of the three-terminal tie lug to ground.

The AVC voltage is developed across the 500,000 ohm volume control. It is fed through the 3 megohm resistor to the grid return of the 12SK7 IF tube. The .05 mfd. condenser connected across this circuit acts as an AVC filter condenser. The remainder of the wiring for the AVC circuit will be described later.

Demonstration No. 33

The Oscillator Coil

The oscillator coil is No. 02862 and comes to you mounted and wired to its trimmer condensers. With the chassis turned over and with the rear of it towards you, the mounting position for it will be just to the left of the volume control. Locate the mounting holes and note that between these two mounting holes are located two larger holes—these permit the insertion through the chassis of a tuning alignment tool from the top. The bright wire winding should be to the right and the other winding should be to the left when the oscillator coil is in position. When in position, the mounting screws will extend through the chassis—use a smaller size nut and lock washer on the top side of the chassis to firmly hold the oscillator coil in place. Make sure the soldering lug on the right end of the coil fits around the right hand mounting screw as this provides the ground connection for the coil.

Demonstration No. 34

The Oscillator Padder Condenser

The oscillator padder condenser is part No. 02868. It is to be mounted on the underside of the chassis between the three-terminal tie lug and the oscillator coil. The framework of the padder is made from ceramic and, to a certain extent, is fragile. So do not drop it or tighten its mounting screws too tightly or it may break. Before mounting this unit on the chassis, it will be necessary to mount on it the mounting bracket for the .0036 mfd. fixed padder condenser. This mounting bracket consists of an insulating strip with a terminal at each end and a mounting hole in the center. Refer to Fig. 5 of 7x1

and note the relative position of this bracket. To mount the bracket on the ceramic form, use a 5/8x6-32 screw, nut and lock washer. Tighten the nut firmly but not too tight—if it is too tight, the pressure might break the ceramic form. With the condenser bracket mounted, the entire form is ready for mounting on the underside of the chassis. Among your small parts, you will find two 3/8 round wood studs with holes in the center. The ceramic form is to be mounted on the wood studs using two 1 1/8x6-32 screws with nuts. Place the form in mounting position making sure the adjustable screw for the padder condenser is over the larger hole in the chassis which will permit adjusting it from the top of the chassis. Insert the 1 1/8 mounting screws from the top side of the chassis and then place the 3/8 wood studs over the mounting screws on the underside of the chassis. Next place the ceramic form over the ends of the mounting screws. Finally, use 6-32 nuts on the ends of the screws. Note the ceramic form is made to fit the hexagon shaped nuts and these nuts must fit down into the ceramic form. Tighten the screw heads from the top side of the chassis until they are just firmly tight—do not use too much pressure.

Demonstration No. 35

The Band Switch

This unit mounts to the right of the volume control and in a manner similar to that of the volume control. On its shaft bushing you will find a nut and washer. Remove these and insert the shaft of the band switch from underneath the chassis. Make sure the small protruding key on the band switch fits into the keyway provided for it—this is very important since this key and keyway keep the entire unit from turning when the control knob is turned. With the switch in the proper mounting position place the washer on the shaft bushing and tighten the mounting nut until it is very tight.

Next place the chassis in front of you so that you are facing the rear terminals of the switch. Note the mounting nut to the left which holds the switch wafer to the framework of the switch—this nut being located between two switch terminals. The switch terminal just above the nut and slightly to the right of it will be terminal No. 1. The next one and slightly to the right of it will be No. 2 and so on around the switch in a clockwise direction, the terminals will be numbered 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Keep this numbering system in mind for the wiring directions will refer to these numbers.

Demonstration No. 36

Connection of Oscillator Parts

The best way to follow the oscillator coil, padder and band switch wiring is to refer to Fig. 5 of 7x1. The oscillator coil assembly is already partly wired so you will not have to make but four connections to it. With the chassis upside down and the rear of it towards you, note there is a terminal at the left end of the oscillator coil. Connect this terminal to the left front terminal of the padder condenser—the one which connects to the variable padder. Connect the

right terminal of this padder to terminal No. 11 of the band switch. Next fit the .0036 mfd. fixed mica condenser (top row of dots black-pink-blue, bottom dow of dots pink-red-red) between the terminals of the insulated mounting bracket which you mounted on the padder ceramic form. Do not solder these leads to the terminals of the bracket until other leads to the same terminals are in place. Next connect the left terminal of the mounting bracket to the lower right terminal of the oscillator coil. Then connect the right terminal of the mounting bracket to terminal No. 10 on the band switch. Next connect the center terminal at the right end of the oscillator coil to No. 2 of the band switch. Next connect the remaining terminal at the right end of the oscillator coil (nearest the volume control) to No. 1 of the band switch. Finally, connect No. 3 of the band switch to No. 6 on the 12SA7 socket. Other connections will be made to the band switch later.

Demonstration No. 37

Coupling Between 12SK7 RF And 12SA7

The coupling between the RF and converter tubes is so arranged to avoid switching between these two stages when changing from one band to the other. This coupling network consists of a 2000 ohm resistor, RF choke coil, .0005 mfd. condenser and a 2 megohm grid leak. The RF choke coil should be mounted first. It is part No. 02864 and is to be mounted between the 12SA7 and 12SK7 RF sockets as per Fig. 5 of 7x1. It is to be mounted on the underside of the chassis with the terminals of the unit away from the chassis. Insert a ¼x6-32 mounting screw down through the bakelite form and tighten on a nut and lock washer from the top side of the chassis. To hold the screw while you turn the nut, insert a small screwdriver down through the bakelite form and prevent the screwhead from turning while you tighten the nut.

Make sure the coil form has the relative position shown in Fig. 5 of 7x1. Next connect one end of a wire and one end of the 2000 ohm resistor (red-black-red) to No. 8 of the 12SK7 RF socket. Connect the other end of the wire to the nearest terminal of the RF choke coil and connect the other end of the 2000 ohm resistor to No. 6 of the 12SK7 RF socket. Next connect the .0005 mfd. mica condenser (top row of dots, black-green-black, bottom row of dots, black-black-brown) between the remaining terminal of the RF choke and No. 8 of the 12SA7 socket. Finally, connect the 2 megohm resistor (red-black-green) between 8 of the 12SA7 socket and the common AVC point on the three-terminal tie lug.

Demonstration No. 38

The Antenna Coil

The antenna coil is No. 02860 and has six terminals. It mounts over the large hole in the chassis in the upper right corner as per Fig. 5 of 7x1. The coil mounts on top of the chassis by means of one mounting foot. Turn the chassis right side up, and you will find its mounting position in the front right hand corner. To mount, place the coil over the large hole

with the mounting foot to the right. Insert a ¼x6-32 screw from the top using a nut and lock washer underneath. Before tightening the nut, center the antenna coil in the large hole making sure none of its terminals touch or short to the chassis. When correctly centered, tighten the nut securely so as to hold the entire coil assembly in place. Now turn the chassis over with its right end towards you. You will then be facing the small round wood mounting stud of the coil. The first terminal to the left of the stud is antenna coil terminal No. 1, the next is No. 2, and so on clockwise around the coil to terminal No. 6 which will be to the right of the round wood mounting stud for the coil. Be sure to remember this method of numbering for the coil as these numbers are used further on in the wiring directions.

Demonstration No. 39

Wiring the Antenna Coil

The band switch is wired to the antenna coil as follows. Connect No. 4 of the band switch to No. 3 of the antenna coil. Connect No. 7 of the band switch to No. 2 of the antenna coil. Connect No. 8 of the band switch to No. 1 of the coil. Connect No. 6 of the coil to the common AVC point on the three-terminal tie lug. Finally, connect No. 5 of the coil to ground—using one of the grounded terminals on the 12SK7 RF socket.

Demonstration No. 40

The Antenna Circuit

With the chassis upside down and the rear of it towards you, the mounting position for the antenna post is near the right corner of the rear flange of the chassis. You are not to use the two holes together almost in the corner but rather the single hole just to the left of these. *The metal part of the antenna post must be completely insulated from the metal chassis.* This is accomplished by using the large insulating washer on the outside of the chassis next to the post and the smaller extruded insulating washer on the inside of the chassis. The extruded part of the smaller washer must fit into the chassis mounting hole, so be sure it completely insulates the threaded part of the post from contact with the chassis. When these parts are correctly fitted, add a lock-washer, soldering lug and nut—tightening the latter so it will hold the entire assembly in place. Finally, connect a wire from the soldering lug on this post to terminal No. 6 on the band switch.

Demonstration No. 41

Miscellaneous Wiring

There remain several circuits yet incomplete before the variable condenser is to be mounted and wired. To complete the miscellaneous wiring, first connect 1 and 3 of the 12SK7 RF socket together and then ground them. Connect No. 1 of the 12SA7 socket to ground. Connect a .00025 mfd. mica condenser (top row of dots, black-red-green, lower row, black-black-brown) from No. 5 of the 12SA7 socket to No. 12 on the band switch. Connect the 20,000 ohm resistor (red-black- orange) from No. 5 of the 12SA7 socket to ground. Connect the 40,000 ohm resistor (yellow - black - orange)

from No. 3 of the antenna coil to ground. Connect 1 and 3 of the 12SQ7 together and ground them. Finally connect No. 5 of the 12SK7 RF tube to the free terminal of the IF wave trap. This completes the wiring of the receiver except for the variable condenser.

Demonstration No. 42

Preparing the Variable Condenser

This is a two gang unit and it needs to be assembled for use. The first step is to mount the dial bracket on the front of the variable condenser. This bracket measures 4⅜x4¼ inches. Its upper left corner is cut off to permit using the dial light on the tuning scale. Its lower right corner extends down about one inch and is bent in the form of a double bracket to hold the tuning control shaft. The dial bracket has one large hole in its center and three extruded mounting holes grouped around the center hole. Place the center hole of the bracket over the gang condenser shaft with the extruded part of the mounting holes next to the gang condenser frame. To fasten the bracket to the gang condenser use three 3-16x6-32 screws and lockwashers the gang condenser frame is threaded to take these screws. The condenser frame will have to be grounded, and this is accomplished by mounting a soldering lug on the right hand mounting screw which holds the bracket to the gang condenser frame. The correct position for this soldering lug is between the 4⅜x4¼ bracket and frame of the gang condenser. One end of the soldering lug has a hole in it. Place this over the right hand mounting screw with the lug extending out away from the condenser frame; later you are to solder a connection to this lug. In placing the mounting screws in position, be sure to use a lockwasher under the head of each screw. With all three screws in position, including the soldering lug on the right hand screw, tighten all three screws firmly tight. This will hold the bracket to the frame of the condenser.

The next step is to mount the dial drive drum on the shaft of the gang condenser. This is done by loosening the set screw in the hub of the drum and slipping the hub over the end of the condenser shaft. Before retightening the set screw in the hub of the drum, see that the rotor plates of the gang condenser are fully closed. Then turn the drum until the hole in its rim occupies about the same position as the number 7 on the face of a clock—see Fig. 2. When it is in the correct position, tighten the set screw in the hub of the drum until it is tightly against the condenser shaft.

Next double the dial string in about its center and feed this doubled end through the hole in the rim of the drum from the inside of the rim—not the outside. Next hook the free end of the spring into

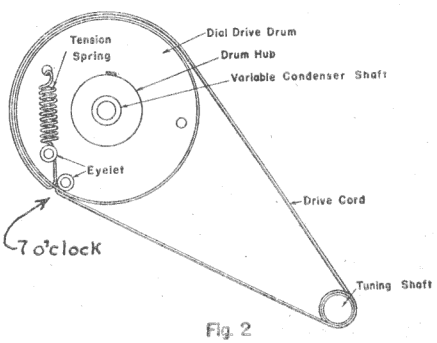


Fig. 2

one of the holes in the flat portion of the drum as in Fig. 2. The tuning control shaft must be mounted next in the two holes provided for it in the lower right corner of the extended double part of the main bracket. This operation will require a little care and patience. On examining the tuning shaft, you will note one end of it has a flat side—this is the end the control knob fits on; the other end fits into the two mounting holes of the doubled part of the bracket. Note that this latter end of the shaft has a ring cut into it near its end and later you are to squeeze a "C" washer into it. Before this tuning shaft is placed through the second mounting hole, two turns of the dial string must be slipped over the end of the shaft. So the first step is to place the end of the shaft through the first mounting hole. Then, before proceeding further, place a screw driver or other small, round tool in the end of the doubled portion of the string and pull the string tightly towards the right until the eyelet at the end of the string is pulled tightly against the rim of the drum—the object being to get the end of the doubled portion of the string as far to the right as possible. Now, while holding the string in this position, remove the screw driver from the doubled end of the string and form two small loops at the doubled end of the string, being careful not to have a twist in the string at the left or towards the drum. When the two small loops are formed, slip them over the end of the tuning shaft. Then place the fiber washer over the shaft. Next extend the end of the shaft through the second mounting hole in the bracket. On the other side of the bracket, you will find the end of the shaft with the ring in it. Fit the "C" washer in this ring and then squeeze the "C" washer together with pliers until it fits loosely in the ring in the end of the shaft. The object of using the "C" washer in this way is to prevent the shaft from slipping out of the second mounting hole in the bracket. Figure 3 shows how the final assembly should appear.

The final step in the stringing operation is to fit the string over the track on the rim of the drum. Figure 2 shows the details of this. If it should happen that your string is too loose when you have it assembled, you can take up the slack by tying another string in the end of the eyelet shown in Fig. 2 and tying the other end of it in the second hole of the flat portion of the drum. Ordinarily, however, this should not be necessary as the string is cut to fit when assembled as in Fig. 2. With the string over the drum and around the tuning shaft, as in Figs. 2 and 3, you should be able to turn the tuning control and so turn the gang condenser throughout its path of rotation. If you cannot do this, then there is something wrong and you

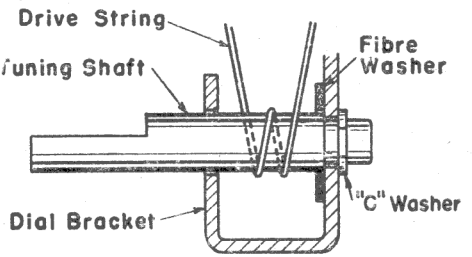


Fig. 3

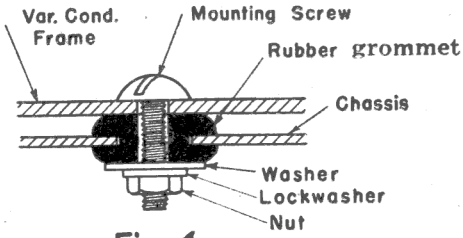


Fig. 4

will have to check back over your work to correct the error.

Demonstration No. 43

Mounting the Variable Condenser

The approximate mounting position for the variable condenser is shown in Fig. 1. This unit is held in place by three mounting screws —one at the rear and two at the front. The entire gang condenser, bracket and tuning scale must be mounted on rubber grommets. These are the 5-32 grommets for ¼ inch holes—there are three of them so you should easily identify them. The mounting details are shown in Fig. 4. First place one of the grommets in the ¼ inch hole which you will find almost between the 12SA7 and 12SK7 RF tubes. Make sure the edge of the grommet extends both above and below the chassis. The other two mounting holes are on the front flange of the chassis. One of them is about in line with the antenna coil, and the other is about in line with the 12SA7 tube. Place rubber grommets in both of these holes. Next among your parts you will find an angle bracket. One side of this angle bracket is 1½ inches long and the other side is ½ inch long. This is to be mounted on the rear of the gang condenser frame. The 1½ inch side of the bracket fits against the condenser frame with the ½ inch side extending out away from the unit—it will act as a mounting foot. To fasten the long side of the angle bracket to the condenser frame, use a 3-16x6-32 screw—you will find a threaded hole in the condenser frame, for this screw. Do not tighten the screw too tightly until you have the entire unit mounted—it should be loose enough to permit the bracket to turn; later, when the mounting is complete, you can tighten this screw. On the bottom of the condenser frame you will find two flat soldering lugs. Bend these so that they extend straight down. The condenser is now ready for mounting. Place the ½ inch side of the condenser bracket over the mounting hole with its grommet. Insert a 5/8x6-32 screw in the mounting hole—do not force the screw through the grommet by pushing —rather turn it to the right with a screw driver. In this way, the grommet will not be forced out of its hole. Place two 5/8x6-32 screws in the two front mounting holes in the same general way. On the other side of the chassis use a flat washer, a lock washer and a nut —see Fig. 4. Do not tighten the nut too tightly—just tight enough to flatten the lock washer. Remember the variable condenser is supposed to float on the rubber grommets, and it will not do this if the mounting screws are too tight. Next tighten the 3-16x6-32 screws of the mounting bracket at the rear of the condenser, and the condenser bracket will be held firmly in place.

The next step is to fasten the tuning scale to the large condenser bracket. This is done by using

four 5/8x6-32 screws and four 3/8 wood spacers or studs. You will note the bracket has mounting holes which are threaded for these screws. Use the four 3/8 wood spacers between the dial and bracket —one for each mounting screw.

With the tuning scale properly mounted, you are ready to add the pointer or tuning scale indicator. Note the end of the condenser shaft has a hole in it—force the hub of the pointer in this hole in the end of the shaft. With the condenser plates fully enmeshed the correct position for the pointer is at the horizontal line which divides the two scales. This completes the mounting of the variable condenser, tuning scale, etc.

Demonstration No. 44

Finishing the Wiring

Among your parts you will find a length of stranded copper wire which is tinned at both ends. Solder one end of this wire to the soldering lug which you mounted on the variable condenser frame and connect the other end of the wire to the No. 5 terminal on the antenna coil. Next connect the No. 12 terminal of the band switch to the nearest variable condenser terminal. Next connect the No. 9 terminal of the band switch to the other variable condenser terminal. Then connect a wire from No. 4 of the 12SK7 RF tube to the same variable condenser terminal. Finally grasp the spring metal tips of the pilot bulb between your fingers (squeeze the tips together) and insert them in the mounting hole in the tuning scale—release the pressure on the metal tips and the pilot bulb assembly will be held firmly in place. Feed the two connecting wires of this assembly straight back past the choke coil and then down through the rubber grommet through which the two choke coil leads are placed. On the underside of the chassis, connect these two leads to terminals 2 and 3 of the 35Z5 tube. Your receiver should now be completely wired and ready for tuning adjustments.

Demonstration No. 45

The Effect of the Pilot Bulb

You will remember in connection with the filament demonstrations for this receiver that the ef fect of the pilot bulb was mentioned. With it now connected to the receiver, you can get a demontration of the way it is supposed to act. Make sure your wiring is in good order and that the previous wiring work has left no possibility of a short circuit or wrong connection. Plug in the power line plug and turn on the receiver. As you do this, note the pilot bulb becomes bright for just an instant, reduces in intensity and then again comes on bright. The first bright flash occurs with the first surge of current. However, the automatic action of the entire series string comes into immediate effect with equalization taking effect across the 2-3 section of the filament, the pilot bulb and 220 ohm resistance. As the tubes gradually heat and start to draw plate current, the brilliance of the pilot bulb will increase. You should reread demonstration No. 15 in lesson 7x1 to have all of the details on this action.

Demonstration No. 46

Adjusting the IF Circuits

At this time, it might be well for you to become familiar with all of the trimmer condensers and their purpose. On the antenna coil at the right front of the receiver you will find two trimmer condensers. The top one is for the short wave band and the lower one is for the broadcast band. Over near the speaker are two oscillator trimmers. The one next to the speaker is for the broadcast band and to the right of it is the one for the short wave band. In about the center of the chassis you will find a variable low frequency padder for the broadcast band—a fixed padder is used for the short wave band. The wave trap adjusting screw is reached from the top side of the chassis, and it is located between the 35Z5 and 12SK7 RF tubes. Each of the IF coils have two trimmer adjustment and these are located in the top of each unit and may be reached through two holes provided in the shield can.

It is no problem at all to adjust the tuned circuits of this radio with the aid of a signal generator or test oscillator. It is difficut, however, to adjust them without the aid of a signal generator and requires time and patience, but it can be done if you follow directions. First, tuning directions will be given assuming you have a test signal, and then directions will be given on how to adjust the circuits without a signal generator. To begin, set the siginal generator to 456 KC. If the signal generator does not have a condenser in series with its high output lead, connect a .1 to .01 mfd. condenser in series with it, and then connect this lead to the No. 8 terminal of of 12SA7 tube. Then connect the low or ground side of the signal generator through a .01 mfd. condenser to the chassis of the receiver. *Turn the volume control on the radio on full.* After both have warmed up to operating temperature, adjust the trimmers of the 2nd IF transformer by turning the two screws on top of the IF coil with a small screwdriver. The trimmer screws are at B+ potential. Therefore, your adjusting screwdriver must not touch the metal shield of the IF transformer. This is necessary to avoid shorting the B+ voltage, and it is why a small blade screwdriver must be used. You should understand that the trimmers must be adjusted for maximum sound output from the speaker.

The IF wave trap circuit must now be adjusted. Remove the signal generator connection from No. 8 of the 12SA7 (but leave the generator set to 456 KC) and reconnect it to the antenna post. Turn the output control of the generator and the volume control of the receiver on full. Loosen the lock nut on the wave trap screw (this is on the top side of the chassis) and adjust the screw for *minimum signal.* When you have the best possible adjustment, hold the setting of the screw with a screwdriver and turn the nut down on the screw until it is tightly against the chassis. In this way the nut will lock and hold the screw in position, thus insuring a permanent adjustment. This screw is in the approximately correct position when its end mea-

sures 13-32 of an inch from the top of the chassis.

Demonstration No. 47

Adjusting the RF Circuits

Set the receiver dial to 1400 KC. Set the signal generator to 1400 KC and couple the high output lead of the signal generator to the antenna post. Connect the low side of the signal generator to ground through a .01 mfd. condenser. Turn on both receiver and signal generator and after they have come up to operating temperature, adjust the RF and oscillator trimmers for maximum output of the speaker.

If you have had past experience with tuning adjustments, the foregoing instructions should be easy for you to follow. On the other hand, if this is your first attempt at this type of work, you may not get the correct adjustment on the first try, and you may have to go over your adjustments once or twice for best results. In working with the trimmer condensers be careful—they are fragile and can be damaged by too much turning or by exerting too much pressure with your screwdriver. Use a small narrow blade screwdriver or an insulated tuning alignment tool, with small blade. *For more instructions on tuning alignment in general, refer to your lessons S-4, and S-5 and S-6.*

The next step is to adjust the oscillator padding condenser for the broadcast band. Tune both receiver and signal generator to 600 KC and turn both on full. Adjust the padder for maximum volume or for maximum reading on your output meter.

For the short wave band, no adjustment of the IF, padder or wave trap is necessary. To make this adjustment, turn the band switch to the *short wave* position. Connect the signal generator to the antenna post of the receiver. Turn both receiver and signal generator on full. Set signal generator and receiver to 16 megacycles. Finally, adjust the oscillator and RF trimmers for maximum volume. This completes the alignment of the receiver with a signal generator.

If you get squeals and howls while tuning over the broadcast band, you have an incorrect tuning adjustment. If this happens, go back over all of your adjustments again, paying particular attention to the IF and oscillator adjustments.

Demonstration No. 48

How to Adjust the IF Without a Signal Generator

Once the IF stages are properly adjusted, the RF trimmers are comparatively easy to adjust, so extreme care should be exercised to get the correct adjustment for the IF stages. To begin, turn the two 2nd stage IF trimmers to the right until they are tight—just firmly tight but not too tight. Next carefully turn each one of them to the left about ¼ of one turn. Be sure you do not turn the trimmer screws more than ¼ of one turn—this is an approximate adjustment — a more accurate adjustment is to be made later. Next turn the trimmer screws of the first IF transformer to the right until they are firmly tight. Finally, turn them back to the left approximately ¼ to ½ turn and leave them in this position for the time being. The pur-

pose of this preliminary adjustment is to get the trimmers set to the approximately correct position. Even though they may not be correctly set at this time, they will be near enough correct to pass a signal from the first detector tube which is the ultimate condition you are trying to reach. Once you get a broadcast signal to pass through the set, a fairly accurate overall tuning adjustment can be made.

Demonstration No. 49

How to Adjust the RF Stages Without a Signal Generator

The adjustment of the RF stages for the broadcast band consists of adjusting the oscillator and antenna trimmers and the oscillator padder. To begin the adjustment, turn the screw of the oscillator trimmer all the way to the right until it is firmly tight. Then turn it back to the left for about ¼ turn. Then turn the antenna trimmer all the way to the right and then turn it back to the left for approximately ¾ of one turn. Next try to tune in a station near you between 1000 and 1500 KC. If you get a signal, identify it by listening for the station call letters. When you have identified the station, see how near the tuning scale pointer comes to the correct frequency. If it does not point to the approximately correct position, take the tuning control knob in your right hand and very slowly turn it until the pointer is in the correct position. At the same time turn the oscillator trimmer either to the right or left with your left hand so that, as you turn the tuning control knob, you continue to hear the signal. In effect, this action changes the tuning of the oscillator circuit and finally brings it into correct adjustment with respect to the tuning scale pointer. Once you receive a signal and get the pointer to read correctly for one frequency between 1000 and 1500 KC as directed, go back over all of your adjustments *including the IF* and adjust your trimmers for maximum volume from the speaker. This will give you a much finer tuning adjustment and should increase the volume considerably.

The final step is to tune the set over the complete broadcast band and checking to see if the signals come in at the proper points on the tuning scale. Do not bother if the signals are off two or three divisions on the tuning scale. If however, the scale pointer shows the received frequency to be off from 50 to 200 or more kilocycles and if you have squeals and howls as the receiver is tuned over the band, *your adjustment is incorrect.* Thus, you will have to go back over your adjustments until the correction is made.

The oscillator trimmer adjustment will change the point on the tuning scale where a given signal should be received at frequencies between 1000 and 1500 KC. The IF trimmers and the oscillator trimmers have the most control on squeals and howls. These all require fine adjustments and even a slight movement of these trimmers makes a big difference in frequency. The antenna trimmer has the least effect on the signal.

When you have the approximately correct adjustment at 1400 KC, turn the receiver tuning control until you can receive a signal be-

tween 500 and 700 KC. In doing this, you should, of course, use an outside antenna or at least a long wire should be attached to the antenna post. When a signal is received between 500 and 700 KC, adjust the oscillator padder for maximum volume. If you are not near a station using a frequency between 500 and 700 KC, you may get a stronger signal at night than during the day. Do not be discouraged if you do not get good results the first try you make with the tuning adjustments. It takes time and experience to make this kind of adjustment without a signal generator, but it can be done if you are careful and patient.

For the short wave band, the best procedure without a signal generator is to tune in a signal on the short wave band and adjust the oscillator and RF trimmers for maximum volume—try to tune in a signal between 12 and 16 megacycles as an adjustment at these higher frequencies will be better than one obtained at a lower frequency. As mentioned before, the approximately correct adjustment for the wave trap screw is to have its end adjusted about 13-32 of an inch from the top of the chassis.

If you have little or no experience at adjusting tuned circuits and if you do not have a signal generator or test oscillator, then you may find it desirable to borrow such a unit. The adjustments are made much more quickly with a signal generator, but one of these is not essential if you follow directions carefully.

Demonstration No. 50

Studying the Effect of an Open Grid Circuit

With all previously described work completed, you should now be ready to study the effects of common defects which occur in most all receivers. The first effect to be studied is that of an open grid circuit.

PROCEDURE

Referring to the 35L6 tube in Fig. 1 in this lesson, unsolder and detach the grid resistor (500,000 ohms) and the grid end of the .02 condenser leaving the grid free or floating. Insert line cord and allow the set to heat as usual. Now touch a moistened finger to the grid (No. 5) of the 35L6 tube.

OBSERVATION

With this done, you will note that the operation of the amplifier has notably changed. Before you actually touch any of the connections mentioned but while you bring your finger near it, there is a definite hum increase. On touching the free or floating grid, note that there is first a very loud and sharp click and then this is followed by a loud hum. It is actually much louder than that formed by a normal signal. There is almost invariably a similar loud click when the connection is broken, and the grid is very sensitive to objects brought near it without actually touching it. A definite increase in hum can be heard when your hand is an inch away from the grid connection.

EXPLANATION

By removing the grid resistor and coupling condenser you have opened the grid circuit, making its impedence run up to a good many hundred megohms. This impedance is incidental leakage of the tube dielectric and other circuit insulation. The grid can be driven, therefore, from an exceedingly high impedance source. The capacity of your hand to the grid may have several hundred megohms reactance to the grid, but, even so, the grid is able to discharge to your body through it. When actual contact is made, the grid, which has accumulated a large negative charge because of electrons being forced to it which cannot escape, is suddenly dissipated or reduced to zero. The resulting surge of plate current causes the loud click. Since the current change is too sudden to pass through the output transformer, it is just as though the transformer circuit were broken suddenly. There is no click this loud when the grid or coupling condenser is touched with the grid resistor in place because the charge given to or taken from the grid is much smaller.

CONCLUSION

An open grid circuit in any output amplifier is known by the extreme sensitivity to the grid. At this point in any circuit of an audio amplifier, the signal must be quite strong because from here it is fed into the speaker. Shielding is not needed and the circuits are not normally sensitive to body capacity or induction hum of this kind. This constitutes a good test for an open grid circuit in any AF amplifier.

Demonstration No. 51

Effect of Opening Input Filter Condenser

PROCEDURE

Disconnect the red lead of the 20 mfd. filter condenser which connects to terminal 8 of the 35Z5 socket. This is the input filter condenser. You should, of course, disconnect the set from the power line while this is being done and try to retain in your mind just how much hum there was in the speaker before you disconnected the condenser. Now plug in the line cord and allow amplifier to warm up for about 1 minute. (Be careful and do not let the red lead of the condenser *short* the other parts.)

OBSERVATION

If this has been done correctly, there will be noticeable hum from the speaker, but it will be distorted and not an even steady hum as before with the filter condenser connected.

EXPLANATION

The speaker field consists of a very high inductance and together with the output filter condenser provides a fairly effective filter of the choke input type. The amount of hum is directly related to the load, everything else remaining equal, and this explains why there is no great increase in hum when the filter condenser is disconnected. The disconnection of the input filter changes the amount of load current only a little. However, the filter action is missing and that is

the reason you get hum and distortion.

CONCLUSION

With the foregoing observations alone, you cannot easily detect an open filter condenser by means of the signal (hum in this case) produced. The distortion and fluttering is, however, an index of an open filter condenser, and when you have this effect, always be sure to check for an open filter condenser.

Demonstration No. 52

Determining the Effect of an Open Output Filter Condenser

PROCEDURE

Open the circuit of the other 20 mfd. condenser by disconnecting it. This is the output filter condenser. Connect the line cord as before and allow the set to heat to proper operating temperature.

OBSERVATION

This time there will be a high level of hum from the speaker. Touch your finger to the input—that is, to the triode control grid lead of the 12SQ7 and note that the hum or noise due to this cause comes through as before and has no apparent effect on the loud hum caused by the condenser being open.

EXPLANATION

You have found how the most common type of hum in receivers is produced. It is, as you have demonstrated, due to lack of adequate filter action needed for the plate circuits of the various tubes. The plate current through the output tube, which must go through the primary of the output transformer, varies as the supply voltage varies. Since there is no output filter condenser to *stabilize the voltage* at the B+ supply of the tube, the AC hum from the line is reproduced because of inadequate filter action.

CONCLUSION

The output filter condenser is, by far, the most important filter condenser from the viewpoint of hum. You have proved that the origin of the hum is from this source. In any set, if you remove the output tube or tubes and still find considerable hum, you will know that the hum cannot come from preceding stages and must be from a source such as this. This test is good whether the amplifier is carrying a signal or not.

Demonstration No. 53

Determining the Effect of an Open Bias Resistor for the Output

PROCEDURE

Unsolder the 180 ohm bias resistor at the 35L6GT socket and detach this end from the socket. Plug in the line cord and carefully listen to the speaker. As before, touch your finger to the input at the triode grid of the 12SQ7.

OBSERVATION

This time the hum will reduce and the test with your finger has no effect on the circuit as before. The signal circuit is definitely broken, and the amplifier is completely dead—the cathode circuit of the output tube being open.

EXPLANATION

The plate circuit of the output tube has been broken at the cathode and no plate current flows through the tube or the output transformer. The original low hum, normal for any AC receiver, has almost completely vanished because its cause was due to the slightly varying supply current flowing through the output transformer. You have seen how there is a ripple voltage at the B+ terminal or how the power supply does not supply pure, direct current. Naturally, when this voltage is applied to the tube plate through the output transformer primary, it will cause a corresponding ripple or variation in the magnetic field of the transformer. This will cause the hum to be reproduced by the speaker.

CONCLUSION

From this, you can see that one thing that can definitely stop the transfer of a signal or even hum through the tube is to have its bias resistor open. This would also be true for any type of tube through which the signal passes.

Demonstration No. 54

Determining the Effect of an Open Screen Circuit

PROCEDURE

Unsolder and detach the screen connection of the 35L6 tube (terminal 4). Plug in the line cord and allow the set to heat for one-half minute as before. Touch your finger to the triode grid of the 12SQ7 tube.

OBSERVATION

It will be noted that there is scarcely any signal and that the hum in the speaker is practically gone—the amplifier is, in general, dead or insensitive.

EXPLANATION

The screen circuit of any tube is a vital circuit in the path of the plate circuit. Screen voltage is essential for the operation of pentodes and tetrodes. When the screen ceases to draw electrons toward the plate, there is very little current; in some cases, none at all.

CONCLUSION

Thus, one of the things that can cause a dead receiver is an open screen circuit. At least, this should be investigated before going into the transformer or power supply circuit to any great length.

Demonstration No. 55

Determining the Effect of a Plate To Screen Short

PROCEDURE

Insert the line plug as usual and allow to heat for one-half minute. Now with an insulated tool, such as a screw driver, short the screen and plate terminals at the 35L6 tube socket and then touch your finger to the triode grid of the 12SQ7 tube.

OBSERVATION

The hum signal which was formerly of reasonable power and good audibility is now low, and there is practically no sound from the speaker at all.

EXPLANATION

As will be seen with reference to the circuit of Fig. 1, shorting of the screen and plate (3 & 4) shorts the output transformer primary terminals. If the plate and screen were shorted, either at the socket or within the tube, this connection would be the result.

CONCLUSION

While the speaker is in place you cannot distinguish between a shorted output transformer and a short which is within the tube, as they both produce the same results. More individual tests on other parts must be made to determine just where the defect is located. In fact, it is the interlocking results of these experiments which are of great value. When several types of defects can cause the came effect, it is necessary to apply different tests to various parts so that one possibility for a defect after another is eliminated.

The next lesson in this series will describe demonstrations and tests to be made with your receiver.